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Original Article

Prevalence, Patterns and Factors Associated with Dyslipidemia Among Adult Hypertensive Patients

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Abstract

Dyslipidemia is a major risk factor for coronary heart disease and is responsible for an estimated 2.6 million deaths annually. Hypertensive patients often suffer from dyslipidemia, which can lead to complications such as ischemic heart disease and stroke. This study examined the prevalence and factors associated with dyslipidemia among adult hypertensive patients admitted to Lira Regional Referral Hospital (LRRH) in Uganda. This cross-sectional study, conducted over three months at Lira Regional Referral Hospital (LRRH), involved 431 patients. Medical examinations and histories were recorded, and blood samples were analyzed to measure high-density lipoprotein (HDL), low-density lipoprotein (LDL-c), total cholesterol (TC), and triglycerides (TG). Dyslipidemia was defined by any of the following: TC ≥200 mg/dL, TG ≥150 mg/dL, HDL-C < 40 mg/dL, or LDL-C ≥100 mg/dL. The data were analyzed using binary logistic regression in SPSS version 26 to identify associated factors. A total of 431 patients were included in the study, with the majority being females over 65 years of age (mean age = 64.7, SD = 8.8 years). The prevalence of dyslipidemia was 48.3% (208) (95% CI = 43.2-52.9%). High LDL levels were observed in 24.4% (105), high TC in 22.5% (97), high TG in 20.0% (86), and low HDL in 20.0% (86 patients). Multivariate analysis revealed that patients with elevated blood pressure, stage 1 hypertension, and stage 2 hypertension had 1.350 (aOR = 1.350, CI = 1.194-1.525, P < 0.001), 1.290 (aOR = 1.290, CI = 1.123-1.482, P < 0.001), and 1.302 (aOR = 1.302, CI = 1.077-1.576, P = 0.007) times higher odds of having dyslipidemia, respectively. Additionally, dyslipidemia was 1.414 times more common (aOR = 1.414, CI = 1.280-1.561, P < 0.001) among current or former smokers and 1.493 times more common (aOR = 1.493, CI = 1.372-1.625, P < 0.001) in patients with diabetes mellitus. The findings highlight a high prevalence of dyslipidemia, emphasizing the need for targeted interventions. Enhancing patient education on antihypertensive therapy adherence and increasing efforts to discourage smoking are crucial steps to reduce the burden of dyslipidemia in hypertensive populations.

Keywords: Hypertension, Lipid profile, Dyslipidemia, Smoking.

INTRODUCTION

World health organization, defined hypertension as sustained high blood pressure [1]. The present study adopted this definition and, hypertension was described as BP ≥140/90 mmHg or any known case of hypertension based on proof for the condition by self-reporting and/or by use of medical records.

Generally, one billion people suffer with hypertension worldwide, which is the most prevalent cardiovascular ailment. It is also one of the primary causes of illness and early cause of death worldwide, accounting for 9.4 million premature deaths yearly[2-4]. Hypertension is estimated to be the cause of 7.5 million fatalities worldwide, or 12.8% of all deaths. Individuals with hypertension have

been associated with a noteworthy prevalence of disability in relation to stroke and ischemic heart disease [5], yet both are consequences of dyslipidemia.

Hypertension is becoming more common in Africa. According to studies conducted in Nigeria, the prevalence of hypertension is 58.9% [6]. Several studies indicate that hypertension is a significant problem in sub-Saharan Africa (SSA), with some communities reporting rates as high as 38% [2].

Projections indicate that dyslipidemia, particularly high total cholesterol (TC), contributes to 29.7 million disability-adjusted life years (DALYs) and 2.6 million annual deaths worldwide, according to estimates from the World Health Organization [7]. One of the main risk factors for coronary heart disease (CHD) is dyslipidemia [8]. When compared to people with normal lipid levels, those with dyslipidemia have a twofold increased chance of having Cardiovascular disease (CVD) [9]. Cardiovascular disease is a major global cause of death that is increasing [10]. Atherosclerosis, the primary risk factor for peripheral vascular disease, coronary heart disease, and stroke (CHD), is increased by elevated blood levels of certain lipids[11].

In Uganda, results of national NonCommunicable Disease risk factor survey showed that Hypertension had an overall prevalence of 26.4% [12]. Of the three studies carried out in the western district of Mbarara demonstrated that hypertension was common at 14.6% [13] and in Kasese the incidence of hypertension was 22.1% for male and 20.5% for female participants [14].

There is limited data about the frequency and cause of dyslipidemia in adult hypertensive patients in Uganda. At Lira Regional Referral Hospital, about 670 patients with Hypertension were managed monthly in the months of September, October and November 2022 in hypertension clinic Individuals with hypertension frequently have dyslipidemia and it results in complications like ischemic heart disease and stroke. However, patients with hypertension attending LRRH are not routinely screened for dyslipidemia yet it leads to many complications. This study examined the prevalence and factors associated with dyslipidemia among adult hypertensive patients admitted to LRRH in Uganda.

METHODS and MATERIALS

Study Design

This was a cross-sectional study conducted at Lira Regional Referral Hospital (LRRH) hypertension clinic from June to August 2023.

Study Site

The study took place at Lira Regional Referral Hospital, a 350-bed facility located in Northern Uganda, serving approximately 2.5 million people from Lira City and surrounding districts. The hospital offers specialized services, including internal medicine, surgery, pediatrics, and obstetrics. Blood samples collected for the study were analyzed at the chemical laboratory of Lira Regional Referral Hospital, which is well-equipped for performing lipid profile tests.

Target Population

The study included adult hypertensive patients aged 18 years and above who had been receiving treatment and follow-up care at LRRH. Participants were required to have been on antihypertensive treatment for more than three months and willing to participate in the study. The following participants were excluded: Participants on lipid-lowering drugs.

Sample Size and Sampling

The sample size was determined using Daniel's formula considering a prevalence of dyslipidemia of 48.4% based on a similar study in Ethiopia [15].

Daniel's formula was employed to ascertain the sample size.

$$n = \frac{(Z\alpha + Z\beta)^2 p(1 - p)}{d^2}$$

where, n = sample size. Zα is the Z-statistic with a 95% confidence level at α = 1.96. P = Prevalence of the attribute being assessed; d = Margin error, set at 0.05; Zβ = Z-statistic at β = 0.84

$$n = \frac{(1.96 + 0.84)^2\ 0.4841\ (1 - 0.484)}{(0.05)^2}$$

From the above the sample size required was 431 participants. The calculated sample size was 431 participants. Consecutive sampling was used to enroll all eligible hypertensive patients during the study period.

Data Collection Procedure and Recruitment

Every week during hypertension clinic days, the principal investigator arrived 30 minutes early to screen and recruit participants, with the assistance of trained research assistants. Before the study started, the principal investigator provided comprehensive training to the research assistants, including one medical officer and three intern nurses, focusing on the study's objectives and the data collection process. Participants were evaluated for eligibility, and the study's objectives were thoroughly explained. Those who met the criteria and agreed to participate provided written consent.

Ethical approval was obtained from Bishop Stuart University's Institutional Research and Ethical Committee (IREC). Permission was secured from the director of Lira Regional Referral Hospital and the head of the Hypertension clinic. Participants were provided with comprehensive information about the study in both English and local languages, and consent was obtained either through signature or fingerprint for illiterate participants. Participants were informed of their right to withdraw at any time without affecting their access to medical care. In line with the hospital's policy, COVID-19 safety protocols were strictly followed during the data collection period. Privacy and confidentiality were maintained by using numerical codes for participants and securely storing completed questionnaires.

Data was collected using a standardized, pretested, close-ended questionnaire made for this study covering sociodemographic, medical characteristics, and lifestyle factors. Medication adherence was assessed using the Morisky adherence scale. Physical examinations included measurements of BMI, weight, height, and blood pressure. BMI was calculated as weight (kg) divided by height in meters squared (m^2).

For fasting lipid profile analysis, 5 milliliters of blood was drawn aseptically by trained laboratory staff, following study protocols. After collection, the blood was kept at room temperature for approximately 30 minutes to allow clot formation. Once clotted, the sample was centrifuged at 2,000 rpm using a fixed-head rotor centrifuge. The serum was then separated from the whole blood and stored at -20°C until further analysis. Lipid profiles—including triglycerides (TG), high-density lipoproteins (HDL), low-density lipoproteins (LDL), and total cholesterol (TC) were measured using an A25 Biosystems clinical chemistry analyzer at the Chemistry laboratory of Lira Regional Referral Hospital.

Quality Control

To ensure high data quality, the principal investigator supervised and double-checked all data collection for accuracy before and after entry into the database by the principal investigator. A pilot study was conducted to test the clarity and functionality of the tools, with the results excluded from the final analysis. Data was systematically coded, cleaned, and stored securely to prevent unauthorized access, ensuring integrity and confidentiality throughout the study.

Data Management and Analysis

The data was coded, cleaned, and entered using EPI data software, then exported to SPSS version 26 for analysis. Descriptive statistics were used to summarize the prevalence and patterns of dyslipidemia. Bivariate and multivariate logistic regression analyses were conducted to identify factors associated with dyslipidemia. Variables with $p < 0.2$ in bivariate analysis were included in the multivariate model. A factor was considered significant at $p < 0.05$.

RESULTS

During the study period, 460 hypertensive patients presented to the study center, twenty-five of the patients were taking statins and therefore were not eligible for the study. Four of the 435 patients that were left did not provide their permission to take part in the research. A blood sample was obtained for the lipid profile and the questionnaire was completed by the 431 patients who gave their consent to participate. The laboratory results were available for all the 431 patients of whom 208 had dyslipidemia.

As Table 1 shows, the study included 431 participants, with the majority being female (276, 64.0%) and aged 65 or older (228, 52.9%), with a mean age of 64.7 years (SD=8.8). Most participants 238 (55.2%) had some level of formal education. Additionally, 303 (70.3%) reported adding salt to their food after cooking, while 294 (68.2%) were

classified as low-risk drinkers according to the AUDIT score. Most participants had never smoked (372, 86.3%), and 393 (91.2%) reported engaging in less than 30 minutes of physical activity per day. (Table 1)

Table 1. Baseline sociodemographic characteristics of study participants

Characteristic	Frequency	Percentage
Age	**Mean=64.7, SD=8.8, Min=40.0, Max=83.0**	
< 65.0	203	47.1
≥ 65.0	228	52.9
Sex		
Male	155	36.0
Female	276	64.0
Residence		
Rural	355	82.4
Urban	76	17.6
Education level		
No formal education	193	44.8
formal education	238	55.2
Religion		
Christian	377	87.5
Muslim	54	12.5
Employment		
Employed	204	47.3
Unemployed	227	52.7
Marital status		
Married	295	68.4
Divorced	64	14.8
Widowed	62	14.4
Single	10	2.3
Salt addition		
No	128	29.7
Yes	303	70.3
Alcohol AUDIT		
Low risk	294	68.2
Moderate risk	98	22.7
High risk	39	9.0
Smoking		
Never smoked	372	86.3
Current/past smoker	59	13.7
Physical activity		
<30 mins/day	393	91.2
≥30 mins/ day	38	8.8

SD=Standard deviation, Max=Maximum, Min=Minimum

Table 2 indicates that the majority of participants (256, 59.4%) had stage 2 hypertension, and most participants had a normal BMI (267, 61.9%). A significant number (301, 69.8%) were on hypertension treatment for over five years. 197 (45.7%) showed low adherence to their prescribed treatment. Most participants (287, 66.6%) were on calcium channel blockers. (Table 2).

Table 2. Baseline medical characteristics of study participants

Characteristic	Frequency	Percentage
BP measured		
Normal	20	4.6
Elevated	38	8.8
Stage 1	117	27.1
Stage 2	256	59.4
BMI	**Mean=23.8, SD=3.1, Min=17.1, Max=37.3**	
Normal	267	61.9
Low	18	4.2
Overweight/obese	146	33.9
HTN Duration + Rx (yrs)	**Mean=6.73, SD=4.18, Min=0.25, Max=23.00**	
< 5.00	130	30.2
5.00+	301	69.8
Treatment adherence		
Medium adherence	234	54.3
Low adherence	197	45.7
CCB		
No	144	33.4
Yes	287	66.6
ACEI		
No	317	73.5
Yes	114	26.5
Other HTN medication		
No	333	77.3
Yes	98	22.7
Diabetes mellitus		
No	369	85.6
Yes	62	14.4
HIV		
No	424	98.4
Yes	7	1.6
Heart failure		
No	419	97.2
Yes	12	2.8

BMI=Body mass index, HTN=Hypertension,
ACEI=Angiotensin converting enzyme inhibitor,
CCB=Calcium channel blocker,
HIV=Human immune deficiency virus, Rx= Treatment

Prevalence of Dyslipidemia Among Adult Hypertensive Patients

With 208 participants, the study's prevalence of dyslipidemia was 48.3%, with a 95% percentage confidence interval of 43.2–52.9% (Figure 1).

Patterns of Dyslipidemia Among Hypertensive Adult Patients

In this study, majority of the patients with dyslipidemia had two categories of lipids deranged. Low density lipoprotein, which was elevated in 24.4% of study participants, was the most common type of dyslipidemia. Total cholesterol was also elevated in 22.5% of study participants, and triglycerides and high-density lipoprotein were both aberrant in 20.0% of study participants. Total cholesterol, low density lipoprotein, triglycerides, and high-density lipoprotein had respective mean values in mg/dL of 177.8 (SD=49.5), 87.7 (SD=36.4), 129.9 (SD=35.9), and 46.2 (SD=14.5). Table 3 below lists the remaining patterns.

Factors Associated with Dyslipidemia Among Adult Hypertensive Patients

Age, residence, education level, employment status, measured blood pressure, adding salt to food after serving, alcohol intake, body mass index, smoking, length of hypertension disease and treatment, physical activity, and diabetes mellitus comorbidity were the variables at bivariate analysis that had p values less than 0.2 and were therefore eligible for multivariate analysis. Since sex was biologically plausible, it was included in the multivariate analysis. Table 4 below displays the remaining bivariate analysis results.

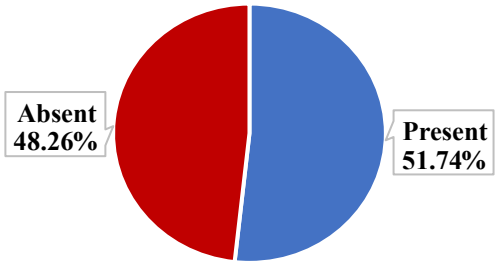

Figure 1. The frequency of dyslipidemia among adult hypertensive patients attending Lira Regional Referral Hospital in Northern Uganda

Table 1 Patterns of dyslipidemia among hypertensive adult patients

Pattern	Frequency	Percentage (95%CI)
Number of deranged lipid types		
None	223	51.7(47.1-56.4)
One	68	15.8(12.3-19.3)
Two	120	27.8(23.9-32.0)
Three	20	4.6(2.8-6.7)
Total cholesterol (mg/dL)	**Mean=177.8, SD=49.5, Min=80.0, Max=292.0**	
Normal	334	77.5(73.3-81.0)
High	97	22.5(19.0-26.7)
Low density lipoprotein (mg/dL)	**Mean=87.7, SD=36.4, Min=13.0, Max=191.0**	
Normal	326	75.6(71.7-79.8)
High	105	24.4(20.2-28.3)
Triglyceride (mg/dL)	**Mean=129.9, SD=35.9, Min=44.0, max=199.0**	
Normal	345	80.0(76.6-84.0)
High	86	20.0(16.0-23.4)
High density lipoprotein (mg/dL)	Mean=46.2, SD=14.5, Min=9.0, Max=73.0	
Normal	345	80.0(76.3-84.0)
Low	86	20.0(16.0-23.7)

Min=Minimum, Max=Maximum, SD=Standard deviation,

Table 2. Bivariate analysis of factors associated with dyslipidemia among adult hypertensive patients

Characteristic	No dyslipidemia, N=223	Dyslipidemia, N= 208	Bivariate analysis		
			cOR	95% CI	P value
Age					
< 65.0	95(22.0)	108(25.1)	Ref		
≥ 65.0	128(29.7)	100(23.2)	0.687	0.470-1.005	0.053
Sex					
Male	82(19.0)	73(16.9)	Ref		
Female	141(32.7)	135(31.3)	1.075	0.725-1.595	0.717
Residence					
Rural	178(41.3)	177(41.1)	1.443	0.873-2.386	0.152
Urban	45(10.4)	31(7.2)	Ref		
Education level					
No formal education	126(29.2)	67(15.5)	0.366	0.247-0.542	<0.001
Formal education	97(22.5)	141(32.7)	Ref		
Employment					
Employed	113(26.2)	91(21.1)			
Un employed	110(25.5)	117(27.1)	1.097	0.967-1.245	0.151

Marital status					
Married	145(33.6)	150(34.8)	Ref		
Divorced	35(8.1)	29(6.7)	0.801	0.466-1.378	0.423
Widowed	35(8.1)	27(6.3)	0.746	0.430-1.294	0.297
Single	8(1.9)	2(0.5)	0.242	0.050-1.157	0.276
BP measured					
Normal	16(3.7)	4(0.9)	Ref		
Elevated	20(4.6)	18(4.2)	3.600	1.014-12.784	0.048
Stage 1	62(14.4)	55(12.8)	3.548	1.119-11.254	0.032
Stage 2	125(29.0)	131(30.4)	4.192	1.364-12.883	0.012
Salt addition					
No	81(18.8)	47(10.9)	Ref		
Yes	142(32.9)	161(37.4)	1.954	1.278-2.987	0.002
Alcohol AUDIT					
Low risk	156(36.2)	138(32.0)	Ref		
Moderate risk	57(13.2)	41(9.5)	0.813	0.512-1.291	0.380
High risk	10(2.3)	29(6.7)	3.278	1.542-6.970	0.002
BMI					
Normal	128(29.7)	139(32.3)	Ref		
Low	10(2.3)	8(1.9)	0.737	0.282-1.924	0.533
Overweight/obese	85(19.7)	61(14.2)	1.661	0.440-1.993	0.146
Smoking					
Never smoked	211(49.0)	161(37.4)	Ref		
Current/past	12(2.8)	47(10.9)	5.133	2.636-9.994	<0.001
HTN Duration + Rx (yrs)					
< 5.00	81(18.8)	49(11.4)	Ref		
≥5.00	142(32.9)	159(36.9)	1.851	1.215-2.819	0.004
Adherence category					
Medium	117(27.1)	117(27.1)	Ref		
Low	106(24.6)	91(21.1)	0.858	0.587-1.255	0.431
CCB					
No	80(18.6)	64(14.8)	Ref		
Yes	143(33.2)	144(33.4)	1.259	0.842-1.882	0.262
ACEI					
No	152(35.3)	165(38.3)	Ref		
Yes	71(16.5)	43(10.0)	0.558	0.360-1.865	0.101
Other HTN medication					
No	184(42.7)	149(34.6)	Ref		
Yes	39(9.0)	59(13.7)	1.868	0.181-2.955	0.208
Physical activity					
<30 mins/ day	207(48.0)	186(43.2)	1.035	0.893-1.199	0.116
≥30 mins/ day	16(3.7)	22(5.1)	Ref		
Diabetes mellitus					
No	221(51.3)	148(34.3)	Ref		
Yes	2(0.5)	60(13.9)	2.413	2.113-2.755	<0.001
HIV					
No	221(51.3)	203(47.1)	Ref		
Yes	2(0.5)	(1.2)	2.722	0.522-14.184	0.235
Heart failure					
No	221(51.3)	198(45.9)	Ref		
Yes	2(0.5)	10(2.3)	5.581	0.208-25.780	0.228

Ref= Reference category, CI= Confidence interval, cOR= Crude odds ratio, BMI=Body mass index, CCB=Calcium channel blocker, HIV=Human immune deficiency virus, Rx= Treatment, ACEI=Angiotensin converting enzyme inhibitor.

Table 3. Multivariate analysis of factors associated with dyslipidemia among adult hypertensive patients

Characteristic	Multivariate analysis		
	aOR	95% CI	P value
Age			
< 65.0	Ref		
≥65.0	0.987	0.370-1.505	0.253
Sex			
Male	Ref		
Female	1.014	0.931-1.104	0.745
Residence			
Rural	1.038	0.937-1.149	0.478
Urban	Ref		
Education level			
No formal education	0.335	0.165-1.853	0.128
Formal education	Ref		
Employment			
Employed	Ref		
Un employed	1.128	0.912-1.396	0.265
BP measured			
Normal	Ref		
Elevated	1.350	1.194-1.525	<0.001
Stage 1	1.290	1.123-1.482	<0.001
Stage 2	1.302	1.077-1.576	0.007
Salt addition			
No	Ref		
Yes	1.081	0.887-1.318	0.438
Alcohol AUDIT			
Low risk	Ref		
Moderate risk	1.348	0.463-3.927	0.584
High risk	1.566	0.482-5.087	0.456
BMI			
Normal	Ref		
Low	0.841	0.450-1.572	0.588
Overweight/obese	1.290	0.684-2.433	0.431
Smoking			
Never smoked	Ref		
Current/past smoker	1.414	1.280-1.561	<0.001
HTN Duration + Rx (yrs)			
< 5.00	Ref		
≥5.00	1.080	0.981-1.188	0.117
ACEI			
No	Ref		
Yes	0.894	0.812-1.984	0.123
Physical activity			
<30 mins/ day	1.035	0.893-1.199	0.648
≥30 mins/ day	Ref		
Diabetes mellitus			
No	Ref		
Yes	1.493	1.372-1.625	<0.001

Ref= Reference category, aOR= Adjusted odds ratio, CI= Confidence interval, HTN=Hypertension, ACEI= Angiotensin converting enzyme inhibitors.

At the multivariate level of analysis, the odds of having dyslipidemia were independently enhanced by uncontrolled blood pressure, current or prior smoking, and diabetes mellitus. In comparison to patients whose blood pressure was normal, patients with elevated blood pressure, stage 1 hypertension, and stage 2 hypertension had 1.350 (aOR=1.350, CI=1.194-1.525, P<0.001), 1.290 (aOR=1.290, CI=1.123-1.482, P<0.001), and 1.302 (aOR=1.302, 1.077-1.576, 0.007) times higher odds of having dyslipidemia. Dyslipidemia was 1.414 (aOR=1.414, CI=1.280-1.561, P<0.001) times more common among smokers who were currently or had previously smoked. Dyslipidemia was 1.493 (aOR=1.493, CI=1.372-1.625, P<0.001) times more common in patients with diabetes mellitus. Table 5 below displays the remaining multivariate analysis results.

DISCUSSION

The purpose of this research was to ascertain the prevalence, trends, and risk factors for dyslipidemia among adult hypertension patients who were treated at Lira Regional Referral Hospital in Northern Uganda. The study primarily consisted of female participants aged over 65, with a mean age of 64.7 years (SD=8.8). Majority were unemployed 227(52.7%). The unemployment is possibly because the age above 65 years is dominated by patients who have retired from their previous jobs and usually under the care of their children.

Though all participants were taking anti hypertensives, majority had a poorly controlled blood pressure with 256 (59.4%) categorized as stage 2 hypertensive according to the blood pressure measured when the data was being collected. The poor control of the blood pressure could be explained by the adherence practices since there was no patient that scored 8/8 in the Morisky adherence scale with all patients categorized either as medium or low adherence. More so, patients in this setting usually skip taking medication on the day of review at the clinic since some think that it could confuse the physician reviewing them.

This study's primary goal was to determine how common dyslipidemia was among adult hypertension patients who were being treated at Lira Regional Referral Hospital in Northern Uganda. The

prevalence of dyslipidemia was 48.3% as it has been recorded in 208 research participants among all. There was a high prevalence of dyslipidemia. Although uncontrolled hypertension was linked to dyslipidemia in this study, the majority of patients had poorly managed hypertension, which may account for the high prevalence. The findings of this investigation with regard to the dyslipidemia prevalence was similar to that of Luo et al.'s study in China, where 52.72% of people had dyslipidemia [16], a meta-analysis of research conducted in Africa, where 52.8% of the population had dyslipidemia overall [17], and a study by Demelash et al., in Ethiopia indicated that among adult hypertensive patients the incidence of dyslipidemia was 48.4% [18].

On the other hand, this study's reported prevalence was significantly greater than previously reported by Pan et al. [19] in China, among hypertension patients aged 18 years in which the prevalence was 34.0%. This discrepancy may be due to the study population's lower mean age than ours, where the majority of participants were older and more likely to have dyslipidemia. Also a study in Congo revealed that 40% of the participants had dyslipidemia [20] which was lower than that seen in our study. This could be because, in our study, most hypertensive patients had poorly regulated blood pressure, where as only (23%) of the Congo study samples had poor blood pressure control. Compared to the findings by Kaddumukasa et al. [21] in Kampala, where dyslipidemia was seen in 33.3% (29/87) of the high risk hypertensives, the dyslipidemia in our study was higher. This is possibly because in the Kaddumukasa et al. [21]study only high LDL and low HDL were considered for dyslipidemia leaving out total cholesterol and triglycerides.

The study's reported prevalence was significantly lower than the one by Ahmmed et al. [22] in Bangladesh where the prevalence of dyslipidemia was 73.5% and in Nigeria where up to 60% of hypertensive patients were found to have dyslipidemia [6]. This is possibly because the Nigerian study enrolled newly diagnosed hypertensive patients in whom the blood pressure control had not been attained.

Finding patterns of dyslipidemia in hypertensive adult patients visiting Lira Regional Referral Hospital in Northern Uganda was the study's second goal. The most common type of dyslipidemia in this study was high levels of lowdensity lipoprotein, which were present in 24.4% of the participants. This was followed by high levels of total cholesterol, which were present in 22.5% of the participants, and finally, deranged levels of both triglycerides and high-density lipoprotein, which were present in 20.0% of the participants. Given that the prevalence of all forms of dyslipidemia ranged from 20 to 25%, this indicates that there was no variation in the proportions of the various types observed in the research population. More so, the confidence intervals for all the four patterns of dyslipidemia were overlapping suggesting that there was no significant difference among the proportions.

Our results are similar to those of by Akintunde et al.[20] in Congo where 23% of the hypertensive patients had hypercholesterolemia. This study's percentage of hypercholesterolemia was more than that published by Peng et al.[23] in China who reported that a total of 819 (11.17%) participants had hypercholesterolemia. The difference is possibly because the study by Peng et al.[24] was a retrospective review of hospital records in which patients that had incomplete records were excluded which could have resulted in a lower proportion. In our investigation, the amounts of TC and LDL were more than those stated by Marcus et al.[24] over a 15 year period in 35 low- and middle-income countries (LMIC), the prevalence of high TC (>240 mg/dL) and high LDL-C (>160 mg/dL) was 7.1% and 7.5%, respectively [24]. This difference is possibly because of the higher cut offs used in the study [25]. More so, the study looked at only new cases (incidence) yet our study was a cross-sectional study.

The mean values for triglycerides, total cholesterol, low density lipoprotein, and highdensity lipoprotein in this study were 46.2(SD=14.5), 87.7(SD=36.4), 129.9(SD=35.9), and 177.8(SD=49.5), respectively. These average values were similar to what was stated by Dixit et al.[25] in India TC, TG, HDL-C, LDL-C, and VLDL-C mean values for female study participants were 202.2 mg/dl, 168.3 mg/dl, 44.9 mg/dl, 123.6 mg/dl, and 33.7 mg/dl, respectively, while mean values for male study participants were 182.5 mg/dl, 128.1 mg/dl, 40.8 mg/dl, 105.4, and 36.2 mg/dl, respectively.

Finding the variables linked to dyslipidemia in adult hypertension patients visiting Lira Regional Referral Hospital in Northern Uganda was the third study goal. At multivariate level of analysis, uncontrolled blood pressure, being a current or past smoker and having diabetes mellitus independently increased the odds of having dyslipidemia.

According to this study, patients with dyslipidemia were 1.350, 1.290, and 1.302 times more likely to have raised blood pressure, stage 1 hypertension, and stage 2 hypertension, respectively, than patients with normal blood pressure. This shows that patients with uncontrolled blood pressure had increased odds for having dyslipidemia. This is consistent with research from Ethiopia that found a strong correlation between dyslipidemia and elevated blood pressure [26]. In addition, a study carried out in South-East Nigeria discovered that lipid abnormalities were more common in patients with recently diagnosed hypertension [27] which is mainly because the blood pressure is not controlled at the time. Furthermore, a study carried out in South-East Nigeria discovered that lipid abnormalities were more common in patients with recently diagnosed hypertension [28]. This correlation between dyslipidemia and uncontrolled hypertension may arise from the endothelial damage caused by dyslipidemia and the consequent decrease of natural vasomotor function, which may make it more difficult to manage blood pressure [26]. A current smoker or past smoker was 1.414 times more likely to have dyslipidemia. In agreement with our findings was a study among Iran's Kurdish population in which current smokers had a higher risk of aberrant triglycerides and HDL cholesterol[29]. It is believed that smoking affects blood lipid levels [30,31]. According to several studies, smoking cigarettes is likely to influence the serum blood lipid levels because nicotine changes the way blood lipids work [32]. Numerous studies have shown that smoking lowers HDL cholesterol (HDL-C) and increases triglycerides, total cholesterol, and LDL cholesterol (LDL-C). Publicly available data indicates that smoking increases triglycerides and decreases total, HDL, and LDL cholesterol [33,34]. A patient with diabetes mellitus was 1.493 times more likely to have dyslipidemia. This is consistent with earlier research showing a significant risk of dyslipidemia in people with diabetes [16,35]. Studies show that fasting blood sugar had a statistically substantial relationship with dyslipidemia [25]. This association may result from diabetes mellitus's disruption of crucial enzymes and lipid metabolic pathways [15].

This study is the first to assess the prevalence of dyslipidemia among hypertensive patients at Lira Regional Referral Hospital, providing important baseline data while including a large sample that enhances the generalizability of the findings to similar populations in Uganda.

The cross-sectional design limits the ability to determine causal relationships between dyslipidemia and associated risk factors

CONCLUSION

At LRRH, dyslipidemia was present in 48.3% of hypertensive patients. Majority of the patients with dyslipidemia had high LDL and two categories of lipids deranged, in hypertensive clinic at LRRH. Uncontrolled blood pressure, being a current or past smoker and having diabetes mellitus independently increased the odds of having dyslipidemia among adults with hypertension attending the hypertensive clinic at LRRH. More emphasis is still needed to put in place measures that can reduce dyslipidemia among patients with hypertension. Regular screening for Dyslipidemia in patients during routine follow-up in the hypertensive clinic so as to improve health outcomes through early diagnosis and treatment.

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Conflict of Interest

The authors declare they have no conflicting interests.

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